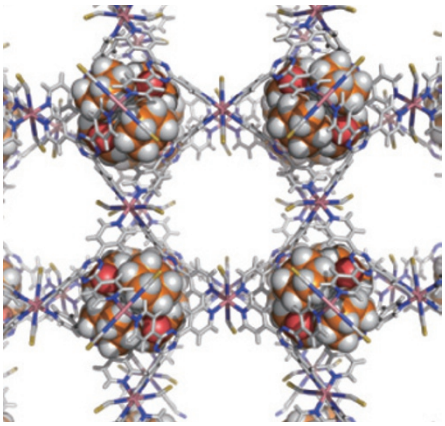
Absorbing analysis

Nature **495,** 461–466 (2013)



X-ray crystallography has the overwhelming advantage, compared with other analytical techniques, that it can determine the absolute atomic configuration of a molecule. Its drawback, however, is the need to obtain a crystal and, as a consequence, the isolation of a sufficient amount of the molecule. Now, Makoto Fujita and colleagues report the crystallographic analysis of a diverse range of organic molecules without the formation of crystals and using nanogram to microgram amounts of material. Host–guest interactions within crystalline sponges are exploited to trap small amounts of the molecules within the porous network. This is achieved by placing the crystalline sponge in a solution containing the molecular species and following absorption of the molecules, in an ordered fashion within the pores, X-ray analysis reveals the structure of both the crystalline sponge and molecules (pictured). The structures of aliphatic, aromatic, non-aromatic, polycyclic and chiral molecules — including a marine natural product whose structure has not previously been elucidated — were determined using this technique. *AS*

Graphene in a spin

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As a consequence of being made up of relatively light carbon atoms, the intrinsic spin–orbit coupling present in graphene is rather weak. This limits its potential for possible spintronic applications, because the spin–orbit interaction enables the generation and manipulation of spins solely by means of electric, rather than magnetic, fields. Jayakumar Balakrishnan *et al.* overcome this problem by adding small amounts of covalently bonded hydrogen atoms to the material, and show this induces an enhancement of the spin–orbit interaction by up to three orders of magnitude. Out-of-plane distortions to the sp^2-hybridized planar carbon bonds have been predicted to enhance the spin–orbit coupling, but introducing these without significantly altering the metallic characteristics of graphene had been problematic. By hydrogenating the material a controlled conversion from sp^2 to sp^3 bonds is undergone, leading to a dramatic enhancement in the spin–orbit coupling. This also enabled Balakrishnan *et al.* to observe the spin Hall effect, which is essential for controlling spin currents, up to room temperature. *AT*

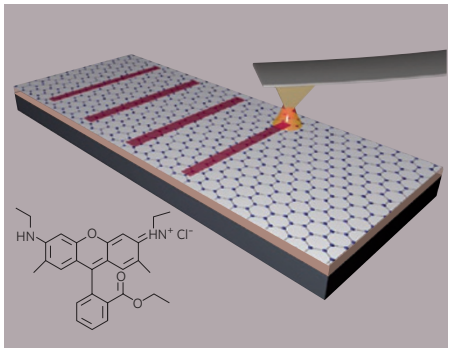
Non-reciprocal plasmonics

Nature Commun. **4,** 1599 (2013)

Faraday isolators are essential optical elements in communication networks and lasers, but are bulky and expensive. Nanoplasmonic systems in combination with magneto-optical materials can allow for breaking the time-reversal symmetry of light propagation when a static magnetic field is applied. Jessie Chin, Harald Giessen and colleagues in Stuttgart and Augsburg now demonstrate that a hybrid plasmonic magneto-optic device is capable of enhancing the thin-film Faraday effect by almost an order of magnitude while maintaining a high level of transparency. The researchers patterned gold nanowires on top of laser-deposited magneto-optical thin films, which showed collective oscillations of electrons and an excitation of photonic waveguide resonances with the proper polarization of the incident light. By carefully tuning the resonances of electrons and photons inside this plasmonic photonic crystal, a dramatic change in the amount of Faraday rotation was observed in the experiment. Their results may open a route for non-reciprocal thin-film devices in magnetic sensing and light modulation. *KT*

Localized doping

Nano Lett. http://doi.org/k3k (2013)



The development of techniques enabling the localized modification of the electric properties of graphene is an essential step to fully exploit this material as a versatile platform for electronic devices. Zhou *et al.* now demonstrate the use of dip-pen nanolithography to pattern Rhodamine 6G on nanosheets of exfoliated graphene with submicrometre resolution. The bulk functionalization of graphene with this aromatic molecule induces an n-doping effect on its conductivity. Accordingly, the nanosized stripes of Rhodamine 6G locally modify the electrostatic potential of graphene as measured by Kelvin probe force microscopy. A stable molecular assembly is achieved when Rhodamine 6G dimers, instead of monomers, are deposited from aqueous solutions: their different electrostatic arrangement favours the formation of ordered one-dimensional chains that closely pack together and bind to the underlying surface by π–π stacking. Such chemical attraction between the planar honeycomb structure of graphene and aromatic molecules is the key to reliable positioning of localized dopants by means of dip-pen nanolithography. *LM*

Divide and convey

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In cell membranes, lipid-anchored signalling proteins — such as the molecular switches Ras GTPases — are known to segregate into domains each consisting of only a few proteins. Such small clusters enhance the efficiency and specificity of signal transmission across the cell membrane. Now, Andrew Mugler *et al.* find that such protein nanoclusters also enhance the reliability of signalling. The researchers solved a stochastic model of membrane-bound receptors and effectors (such as Ras) that are either well mixed in a single domain or partitioned in small, non-interacting subdomains. They found that the partitioned system produced a more graded input–output response (a consequence of larger fluctuations in the number of active receptors), that the response was less noisy (because of suppressed correlations between proteins), and that the optimal number of proteins per partition results from the balance between signal reliability (fewer is better) and propagation (for which a sufficient number of both receptors and effectors is needed). The researchers argue that the removal of correlations through partitioning is a general mechanism in biochemical signalling. *PP*

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